1094-11.

SILICATE of SODA
FOR TREATING CONCRETE

BULLETIN No. 341

PHILADELPHIA QUARTZ COMPANY, Established 1831, 121 S. THIRD STREET, PHILADELPHIA

THE ILLUSTRATION ON THE COVER

Suspension Towers and Central Pier of the San Francisco-Oakland Bay Bridge under construction. Concrete piers treated with Concrete Special Silicate

This is one of a series of bulletins describing SILICATES OF SODA, what they are and how they are used in Industry. Other bulletins will gladly be furnished on request to our general offices.

No. 101—(M)—11-15-35
Printed in U. S. A.

SILICATE of SODA
FOR TREATING CONCRETE

Showing the minute cells in concrete
(Enlarged one and a half times)

THE technique of making concrete has been improved to such a degree that today interest is focused on the substances which, used in conjunction with concrete, enhance its useful properties.

Silicate of soda is one of the most useful of these accessory materials, but like the cement itself it yields the best results to those who thoroughly understand how it works.

In conjunction with concrete, silicate of soda has two distinct functions and it is well to define these clearly so as to avoid confusion. One use is for curing concrete, the object here being to produce a film on the surface of the concrete and to prevent penetration as much as possible. This tends to hold the water in the concrete, on which depends the maximum ultimate strength. The curing of concrete has been covered in our bulletin 31, "Curing Modern Concrete Roads," a copy of which will be furnished on request.

Another class of uses calls for penetration of the silicate into the concrete, and it is this that we shall discuss here. This application is made after the Portland cement has taken its set, so that maximum reaction between the cement and silicate may be obtained.

THE POROSITY OF CONCRETE

All concrete is porous, although the porosity varies greatly in different concrete. This is due to the chemical and physical changes which take place as the concrete sets, but it is modified by the amount of working, the amount and kind of aggregate, temperature and various other conditions.

Look at this photograph (enlarged one and a half times) and get a true picture of the tiny cells of which every bit of concrete is made up.

HARDENING CONCRETE

The stress of traffic such as trucks, vehicles, even foot traffic, causes wear. In many places you have observed concrete that was worn. This wearing action results in a most undesirable dust, whether it be a railway station, a warehouse, an airport or the basement in your home.

The principle of hardening concrete is to allow the penetration of silicate into the surface pores which exist even in the best of concrete bodies. By chemical reaction with the concrete a hard insoluble substance is formed in the surface particles. The right grade of silicate properly applied soaks into the concrete to the depth of $\frac{1}{8}$" to $\frac{1}{4}$". Thus results a hard, wear-resisting, dustless surface on your concrete. Footsteps and wheel traffic no longer can break off the little particles.

The slab of concrete pictured on the next page was treated for half of its length with Concrete Special

Cross section of concrete block hardened with Concrete Special Silicate. Treated with an indicator to show degree of penetration. Note whiter outside edges which show depth of penetration.

silicate. It was tested by rubbing with sand and steel blocks sixty times a minute. The little fin at the right of the slab shows the original thickness. The next step in the picture is the wear caused on the silicate-treated portion, while the third shows the effect on the concrete without the protection of Concrete Special. It took only 3,000 passages of the rubbing blocks to produce the marked contrast shown.

Think what this means on a concrete floor or on roads exposed to heavy traffic. The life of the concrete is so greatly prolonged that the cost of the necessary silicate of soda and labor to apply it is trifling in comparison.

HARDENING AND DUST PROOFING TREATMENT

"Concrete Special" silicate of soda is recommended for this purpose. It is a syrupy solution. Technically, it is 42.25° to 42.75° Baumé, with a ratio of sodium oxide to silica of 1:3.22. It is used in dilution, as noted below, and applied to the surface of the concrete after it has set. After the concrete is in place, it is desirable to wait at least two weeks before applying the silicate, and four weeks is still better. Also the silicate treatment may be satisfactorily applied to clean concrete at any later time, and is especially good on old concrete. Turn to page 5 for instructions on cleaning concrete.

U. S. Bureau of Standards Process: The "Report on Service Tests on Concrete Floor Hardeners" issued by the U. S. Bureau of Standards, Washington, D. C., October 28, 1920, describes the treatment as follows:

"In ordinary cases it will be found satisfactory to dilute each gallon of the silicate with four gallons of water. The resulting five gallons may be expected to cover 1,000 square feet of floor surface, one coat. However, the porosity of floors varies greatly and the above statement is given as an approximate value for estimating purposes.

"The floor surface should be prepared for the treatment by cleaning free from grease, spots, plaster, etc., and then thoroughly scrubbed with clear water. To get the best penetration the floor should be thoroughly dry, especially before the first application, and if practical it is well to let it dry for several days before the first scrubbing. . . . The solution may be applied with a mop or hair broom and should be continuously brushed over the surface for several minutes to obtain an even penetration. An interval of twenty-four hours should be allowed for the treatment to harden, after which the surface is scrubbed with clear water and allowed to dry for the second application. Three applications made in this manner will usually suffice, but if the floor does not appear to be saturated by the third application a fourth should be applied.

"This treatment when properly applied gives a very hard surface that is bright and uniform in appearance."

The above dilution, four gallons of water to one of silicate, is recommended as best for average conditions. The silicate should be spread thoroughly so as to get an even penetration. The aim is to get the silicate absorbed into the concrete. On very dense surfaces it may be necessary, in order to get penetration, to dilute with as high as ten parts of water to one of silicate. In such

Abrasion test showing effect of the silicate treatment

cases scrubbing is desirable, but not necessary.

The scrubbing with clear water between treatments recommended by the Bureau of Standards is not always necessary, but it does help to give better penetration with the second and succeeding coat or coats of silicate. The floor should be kept clean throughout the treatment.

In the Report, the comment on the comparative service test of the silicated section of the floor under observation is: "The panel has been in service two years and two months. The surface is very hard and shows no sign of wear."

The silicate treatment may be repeated if desired. Also it may be applied to concrete that has previously been treated with magnesium fluosilicate or with various special preparations, except that it is not satisfactory on concrete that has been treated with any kind of oil or paint that would prevent penetration.

The frequency of application depends on the amount of traffic. The application, however, need not be repeated until the floor begins to show wear.

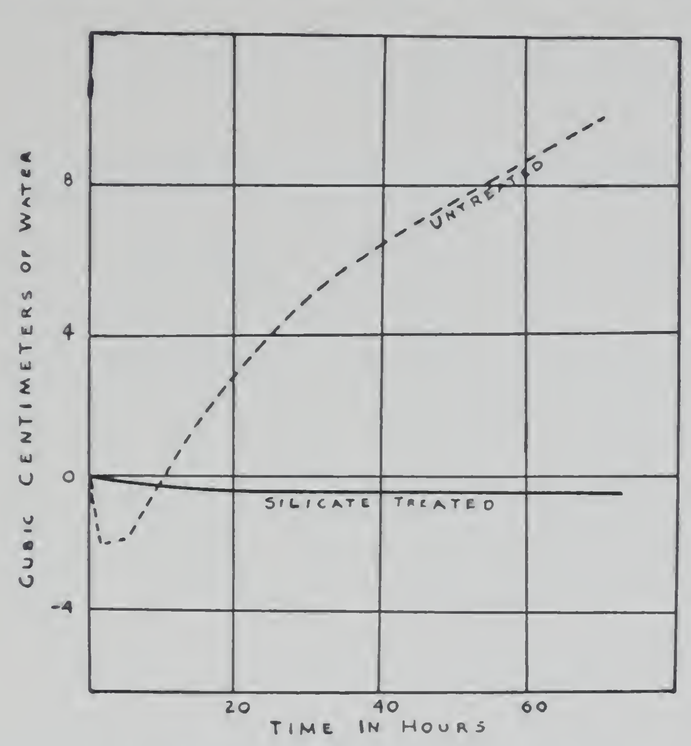
While in our experience the above method is preferable, an alternate method sometimes is used. This consists of a single treatment, with the silicate diluted by the addition of about one quart of water to a gallon of the Concrete Special Brand. This will usually thin it sufficiently to soak in, to some extent, though if the concrete is unusually dense the silicate may be used more diluted. The silicate, preferably warm rather than cold, is washed, brushed or sprinkled over the floor by any convenient means. A mop or push broom, or a watering can, will do. The silicate is spread thoroughly and simply allowed to dry in. One gallon of Concrete Special Brand thus diluted we estimate will cover about 500 square feet of floor.

Too frequent repetitions of this concentrated silicate treatment sometimes build up a layer of silicate on the surface which in itself may cause dusting.

WATERPROOFING CONCRETE

Concrete walls, storage tanks, building blocks, etc., as they are porous, allow water to pass through them to some extent, making them damp and sometimes resulting in actual seepage or leaking.

The surface treatment of concrete with Concrete Special silicate, as has been pointed out, stops up the pores. The concrete consequently is less easily penetrated. The graph shows the improvement in water resistance made by the application of silicate.



Water resistance of concrete treated with Concrete Special

The line which dips slightly and then rises shows what happened when the untreated test block was subjected to a pressure of water corresponding to a column thirty feet high. First, some water was absorbed by the porous block and then, slowly but steadily, it began to pass through, while the silicated piece, subjected to exactly the same conditions, absorbed a little but did not allow any flow to take place. Even the absorption was much less, because of the deposit from the silicate which nearly, but not quite, fills the capillary spaces. The cement mixture was made with two parts of sand and one of cement. The untreated block took up more than twice as much water in one hour as the treated block in seventy hours. This means that a silicate treatment is very useful to make less permeable any concrete which is required to resist water under pressure, as in cisterns and dams. The material deposited in the pores is a hard gel which is known to be durable on long exposure to water and is not subject to the various kinds of disintegration suffered by organic waterproofing agents which, for a time, repel water better than the silicate treatment.

For waterproofing, the same process as recommended by the Bureau of Standards for floors is satisfactory, with at least four applications. Other people have used progressively more concentrated solutions, starting with a first application of one part of Concrete Special diluted with five parts of water, then a treatment with four parts, and then another with three parts.

It should be understood that this treatment serves to fill the pores of the concrete and to ren-

der the surface more resistant to the passage of water. It is not designed to fill or caulk cracks or checks, though experience shows that it does sometimes help to fill fine hair lines.

CONCRETE BUILDING BLOCKS

Treatment of concrete building blocks with diluted Concrete Special silicate will make them harder and more resistant to moisture. A single treatment with Concrete Special diluted by the addition of four gallons of water to one of the silicate has considerable effect; but still better results are obtained if the treatment is applied two or three times. The blocks should have been made up for two to four weeks before the silicate treatment is applied. Sometimes a whitish bloom develops on concrete blocks. In some cases silicate prevents the blooming or changes it to a form which can be washed off.

Cellar walls built of concrete blocks, as well as all other cement walls, can be tightened up against moisture by treatment with Concrete Special silicate. The U. S. Bureau of Standards process (page 2) is the best. The silicate can be applied with a clean whitewash brush or mop. If a spraying outfit is used, be careful that the nozzle does not get clogged up with dried silicate. Also the silicate will need to be more dilute.

OIL PROOFING CONCRETE

Protection against oil penetration is especially important in garages and service stations for floors, driveways and runways. The treatment with Concrete Special silicate is the same as that for waterproofing. By preventing the absorption of oil into the pores of the concrete surface, oil and grease can then be readily cleaned off. Also the silicate method has been used successfully on oil pits in garages.

Concrete Special silicate has great value in preventing disintegration of concrete by oils. Freshly poured concrete needs water to obtain its final set. If oil is put on it, the oil drives out the water which is needed for the curing. Oil therefore prevents the full curing of the concrete. Moreover, even on fully set concrete, oil causes disintegration.

A dried silicate solution in the pores of the concrete offers high resistance to oils. Dried silicates are glass-like bodies and resist liquids which do not dissolve them. Free fatty acids may be partly saponified if the silicate in the pores has not been sufficiently dried, but no reaction takes place in the absence of water. Silicate-impregnated concrete is thus an excellent container material for mineral and vegetable oils.

To protect concrete from oils, storage tanks

Concrete floor treated with Concrete Special for acid resistance. Photographed seven years later.

Applying Concrete Special Silicate to a concrete floor

should have a treatment with silicate similar to that for waterproofing concrete. The process recommended is as follows:

1st application,	1	part of	silicate	and	3	parts of	water			
2nd	"	1	"	"	"	"	2	"	"	"
3rd	"	1	"	"	"	"	1	"	"	"
4th	"	1	"	"	"	"	1	"	"	"

The silicate of soda treatment is useful also to prevent absorption by the tank walls, and the consequent oil loss.

MAKING CONCRETE ACID RESISTANT

Concrete is rapidly attacked by acids, but when protected by Concrete Special silicate it is remarkably acid resistant. The silicate of soda forms in the concrete pores a strongly acid-resistant material.

Concrete Special prolongs the life of concrete subjected to acids. In our laboratory a block of concrete was prepared with the silicate treatment applied to one end and not to the other. Concentrated hydrochloric acid was poured over the block. The acid ate rapidly into the untreated end, leaving it friable and sandy. The treated end was only slightly affected.

On page 4 we see a concrete floor laid in 1926, and treated with three applications of Concrete Special. It has been subjected continuously to acid splatterings, trackings and fumes, and today is still in good condition.

The silicate treatment also has done good service where old floors had to be used. The treatment is useful for protection against dilute acids, and against organic acids. In some cases repeated silicating, perhaps once a year, may be desirable.

To make concrete acid resistant, the treatment recommended for dustproofing is remarkably serviceable.

Silicate of soda is also effective in protecting concrete against the attack of brackish water.

PATCHING CEMENT

Because Portland cement does react so promptly with silicate solutions, we are often asked regarding its use in the admixture. The effect of adding small amounts to the gauging water is to increase the speed of set, but to reduce the ultimate strength. Where high strength is unimportant and quick setting is necessary, 10 per cent of silicate may be used in the gauging water.

In patching or resurfacing concrete, Concrete Special can be used to insure a good bond between the old and new cement.

To refill a hole, it should be chipped out clean and somewhat under-cut. The fresh surface should then be painted with Concrete Special silicate full strength. Neat cement should next be dusted over the surface and worked in with a broom or stiff brush. The new concrete can then be applied in the usual manner.

For resurfacing, the concrete should be roughened with a pick, all loose particles removed and the floor wet thoroughly with water over night. Immediately before the new surface is applied the old one should be washed with a freshly prepared mixture of 10 pounds of neat cement with one quart of Concrete Special in fourteen quarts of water. This mixture should be brushed in well and followed at once with the surface layer.

CLEANING CONCRETE

A popular garage floor cleaner is Metso 22 *. The outstanding characteristic of Metso as a concrete floor cleaner is that the surface becomes progressively easier to clean, because after the first washing, dirt does not adhere so easily.

When treating old concrete against oil pene-

* U. S. Pat. 1898707.

tration, dusting or wear, the surface should first be cleaned thoroughly.

One convenient method of washing concrete: Wet the floor, driveway or runway. Sprinkle with Metso, about 1-2 pounds per 100 sq. ft. Allow to soak 5-10 minutes. Scrub with broom. Rinse off with clean water.

Another way is to make up a cleaning solution by adding 3-5 pounds of Metso per gallon of hot water.

SILICATE TECHNICAL ADVICE

Our Chemical Laboratories check carefully our silicates against the standards fixed for the various P. Q. Brands. Besides, their advice is available to users or prospective users of silicates. It is not uncommon for one of our chemists to consult on a problem or a new process in the field and then devote study and experiment to it in our laboratory. We respect confidences.

Technical service frequently requires the engineer's judgment. Our Engineering Staff designs our plants and construction, but also is prepared to offer our customers counsel about silicate storage tanks, handling equipment and silicate using machines.

Each of our brands has been perfected with reference to the special properties required for certain uses, and the quality worked out in each case to give just the service needed. Therefore we have established definite standards and the custom of the trade is to designate these standards by brand names. We suggest you specify—

Concrete Special—for treating concrete

Metso 22—for cleaning concrete

These silicates are carried in stock by dealers in all large cities. Our own plants also are conveniently located. Price depends upon quantities and packages and we shall be pleased to give information as to the most economical way to get what is needed for your work.

FROM CONCRETE BRIDGES TO DENTAL CEMENTS

In this bulletin the uses of silicate of soda as a film on concrete surfaces have been described. In addition to these applications a number of special cements are made with P. Q. silicates as ingredients. Various materials mixed with the right silicate of soda produce excellent heat-resisting and acid-resisting cements of high strength and low cost.

USES OF P. Q. SILICATES WITH CEMENT AS AN INGREDIENT

Abrasive Wheels

Acidproof Cements

Dental Cements

Furnace Cements

Glass and Metal Cements

Linings for Petroleum Cracking Chambers

Linings for Paper Pulp Digesters

Sagger Cements

Spark Plug Cements

Philadelphia Quartz Company

ESTABLISHED 1831

General Offices: 121-129 S. Third St., Philadelphia

Chicago Sales Office: 205 W. Wacker Drive

Works: Chester, Pa. Anderson, Ind. Baltimore, Md.

Kansas City, Kans. St. Louis, Mo. Rahway, N. J. Utica, Ill. Gardenville, N. Y.